Arca umbonata Lam.
Arca occidentalis Phil.
Noetia ponderosa Say
Atrina rigida Dillw.
Atrina serrata Sowb.
Ostrea virginica Gmel.
Spondylus americanus Lam.
Pecten gibbus Lam.
Pecten gibbus amplicostatus Dall.
Anomia simplex d'Orb.
Mytilus recurvus Raf.
Echinochama arcinella L.
Lucina pectinatus Gmel.
Loripinus chrysostoma Phil.
Cardium muricatum L.
Cardium robustum Sol.
Laevicardium serratum L.
Laevicardium mortoni Conr.
Dosinia discus Reeve
Dosinia concentrica Born
Pitar texasiana Dall
Chione cancellata L.
Chione intepurpurea Conr.
Chione latilirata Conr.
Venus campechiensis Gmel.
Petricola pholadiformis Lam.
Tellina tenera Conr.
Tellina tampaensis Conr.
Macoma constricta Brug.
Macoma tageliformis Dall
Semele proficua Pult.
Abra aequalis Say
Donax denticulata L.
Donax variabilis Say
Tagelus gibbus Spengl.
Mactra fragilis Gmel.
Mulinia lateralis corbuloides Desh.
Rangia flexuosa Conr.
Labiosa canaliculata Say
Barnea costata L.

NERITINA VIRGINEA L., IN JAMAICA, B. W. I.

BY E. A. ANDREWS

INTRODUCTION

The present paper seeks to describe localities where the gasteropod *Neritina virginea* L. was collected in 1910 and 1932, and to correlate size and pattern of shell with environment.

Collections were made: in Northern Jamaica in sea water at White House and at Sandy Bay; in saline estuarine waters at Mo Bay in the Brackish Pond and the Lagoon of the mouth of the Montego River; in the fresh waters of a stream at Port Antonio and the Town Creek of Mo Bay and Mount Pleasant stream, as well as the rivers Retirement, Montego, Flint, Great, West Lucea; in Southern Jamaica: Fort Clarence Salt Pond; Rock Port Spring and the rivers Black and Cabaritta.

DESCRIPTIONS OF LOCALITIES

1. *White House Shore, Mo Bay.* Along the north coast are stretches of reef leaving quiet shallow shore waters with fine limy

bottoms with algae and gasteropods. One such is a few miles East of Mo Bay, near the town quarry and stone crusher, with shore fringed with mangrove. In 1910 a few small shells, and in July 1932, locality not changed and many crawling scattered one or two to square foot amidst eel grass but two inches in height. Water clear and quiet, gravity taken five feet from shore 4 inches deep and also 20 feet out and 6 inches deep, the same, with air and water both 30.8° to 31.2° C. On a few large stones were *Nerita versicolor* and *Nerita tesselata*. A half mile farther East many dead shells and fragments midst dead eel grass cast up under mangroves.

2. *Sandy Bay.* Another like region West of Mo Bay back of the village where shore is low and planted with cocoanut, yielded many crawling near the shore in August 1910, along with many inhabited by hermits and many bored by some mollusk. In July 1932 the locality was little changed, conchs and other gasteropods taken by natives to sell to tourists. The snails have a high polish yet are not conspicuous on fine limy bottom with dwarf eel grass and mossy alga, crawling in 2–10 inches clear water exposed to full sunshine from shore out 150 feet to a sand bar, bare at low tide. Some shells and small lime pebbles bore egg capsules. In a half hour with the aid of women and children gathered near quart, but of these 894 proved *Nerita tristis,* resembling larger banded *N. virginea.* A half mile to West the same environment, minus the human element, yielded many scattered again only few to the square foot, in water 2–6 inches 20 feet out and 8 inches 150 feet out, with temperatures from 29.9° to 31.3° when air was 30° to 31.8°.

3. *Great Salt Pond, Fort Clarence.* This large body of saline water near Kingston Harbor is at times open to the sea and had a varying population as collected in 1891, 1910, 1932, and 1936; the main results are indicated in the table and more details published elsewhere ("Ecology"—1940).

4. *Montego River Lagoon.* At the mouth of this river on edge of pasture set with cocoanut the sea had thrown a sand barrier 125 feet wide, forming a lagoon 250 feet long parallel to shore and into it entered a little stream, Little Pye River, near the mouth of which there were great herds of snails on sand, in shal-

low water, gathered by handfuls as 7–8 quarts, end of August 1910.

The sea outside the bar was affected by the two rivers so that its density was read as 1.0034–1.0048. In July 1932 no snails were found; the region was entirely changed; cane fields had extended and the Little Pye had been diverted into Montego farther up, to leave fields free of floods; sand flats and lagoon had disappeared.

5. *Brackish Pond, Mo Bay.* This is a T-shaped pool near the iron hull of an old ship and was evidently an old mouth of the Montego River, 150 feet back of it and sometimes overflowing fresh water into it.

The length of the stem of the T was 325 feet, and its larger arm, toward the town, 300 feet, and the smaller, 200 feet; the width was 50 feet, and the greatest depth, 15 feet.

In 1910, long cut off from the harbor by a sand beach 125 feet wide, the end toward the beach was but a few inches deep and on sand and green algae just below, as well as above the water line, browsed dense herds, so that handfuls were easily collected in June, July, and August.

It then functioned as a trap in which marine organisms were held captive and subject to changes in salinity. Its fauna included twelve sorts of fish: namely, 5 species of Snapper, Jack, Yellow Coat, Gar, Barracuda, *Elop saurus,* Mullet, Darter, and Shad. A dozen sorts of crustacea, blue crab, Zoeas of some crab, white crab, *Cardisoma guahnhumi,* mangrove crab, *Goniopsis cruentata* Latreille, our *Panopeus herbstii* Milne Edwards, small shrimp, *Upogebia affinis,* large *Callianassa*-form *Lepidopthalmus* (then undescribed), Amphipod, *Alpheus,* Stomatopod larva, Ostracods, and Barnacles. Such mollusca as *Mytilus,* thick oyster and nudibranchs, with sea anemone larvae; Ctenophores and yellow sponges along with algae near the bank, and a patch of eel grass.

In July 1932, a canoe entered against a strong wide outflow across the beach and no snails were found in this greatly changed end of the pond; moreover, mangrove and other trees had been cut and shore toward the town used as a dump for rubbish that overflowed into the greater arm of the pond. Near the blind end

of this, snails were browsing, scattered over green slime on tire casings, horns, and parts of cattle skulls, bottles, pots, shoes, etc.

6. *Town Creek, Mo Bay.* In July 1910, water from the large City Spring, in its bricked housing, was used for an adjacent washing shed and the soapy water discharged into the creek. From the spring the Creek ran to the harbor between walls with about a foot of water that floated a rowboat, over bottom with stringy mould or bacterial growths, small fish, and tadpoles. Scattered on the bottom and crowded in shade of cut-out bottom of wall, a quart of snails collected in a few minutes along with some *N. punctulata*, and many *Neritilia succinea*. In July 1932 no snails could be found: the wash house was no longer; men were digging out deep sand from the creek, bearing tufts of alga above and contaminated below, where entering harbor. In the spring were small fish and clear shrimp, while square crabs ran on wall.

7. *Port Antonio.* In 1891, 18 dark shells along with 28 *N. punctulata* were taken on and under stones with algal growths in dark woods at trail crossing of small brook up the hill near reservoir. In 1896 or 1897 Dr. F. S. Conant sent Dr. Metcalf 500 somewhat smaller, 6–9 mm., shells from some stream in Port Antonio, possibly at saline mouth, like those Metcalf took in Great Salt Pond, Ft. Clarence, but with yellow in place of white background.

July 1932: a vain search for any in springs and streams about reservoir and all along East Town River; yet natives aver these fresh water "bossu" come out at night and might be found "tomorrow," and that they are delicious cooked and picked out, but do not go into sea where there is another sort, *Nerita*. Apparently greatly increased population with added cultivation has nearly exterminated these river snails here.

8. *Cabaritta River.* July 1932: abundant upon cement foundations of highway bridge West of Sav la Mar; a handful in a few minutes, at surface and larger two inches down in dense dark algae, exposed to full sun except under bridge. Water drunk by natives, and just below bridge clothes are washed, but boats come up from sea.

9. *Broad River branch of Black River.* July 1932: by rowboat up about mile to first large branch of Black River and collect at a

turn where a central group of waterlily flowers and serrated leaves ("pancakes") and cocoanut leaves stuck down six feet to muddy bottom by fishermen. Snails with egg capsules on these leaves and stems and on *Ruppia maritina* L., from surface down several feet. Strong outward current, water dark coffee-colored, tasted fresh, but natives said was more brackish at high tide, with immature bivalves of *Mytilopsis leucophaeta* Conrad, the alga, *Compsopogon aeruginosus* J. A., living serpulas in tubes and brown and green sponges, identified by Dr. Penny in 1933 as probably *Spongilla*.

Also some distance down river along banks on plants such as water hyacinth, more of these peculiar smooth, dark forms that may be what C. B. Adams found here and called *Neritina tenebricosa*.

10. *West Lucea River*. July 1910: quart and a half in half hour; clear water 6 inches to 2½ feet, scattered over densely shaded, dark gravel bottom and more numerous on floating logs and bamboos, reached by rowboat half mile above main road. Also half mile farther up where road crossed by ford at washing place, many snails on puddingstone rock in water 2 feet depth.

July 1932: both East and West Lucea Rivers swollen muddy flood, but up West Lucea River where road crosses on high bridge at Eton sign post, above and below bridge, waist deep rapid muddy stream, scattered widely on dark pebbles, scarce, but several on few larger stones. Egg capsules on small stones.

11. *Flint River*. August 1910: on and under dark stones of dark bottom, under bridge where main road crosses, also in full sunshine of pasture above bridge, rapid cool water, some in spring on bank.

July 1932: under bridge and 20 feet upstream rapid, clear cold stream 6–18 inches penetrated by sunshine, on white flint and dark stones with more *N. punctulata* and *N. succinea*. Great numbers of egg capsules of all three, especially along depressions, often 20–40 per square inch, but also scattered widely over surfaces of stones.

12. *Mt. Pleasant Stream*. July 1932: rapid clear, little over foot deep, below culvert under main road from S. Nigril to Green Bay, scattered 5–10 to square foot, on small stones with algal

tufts with equally numerous *Neritilia succinea* and fewer *N. punctulata*; many egg capsules of all three.

13. *Montego River.* August 1910: end of rowboat access about mile from mouth, back of Barnett Mill, numerous in rapid stream from mill race and on stone abutment, feeding on microscopic green algae, and in cold spring on bank, also some few on stones of sluice and in river. 2½ quarts.

July 1932: by canoe to back of Mill, on stones in rapid shallow river.

Montego River Bridge. June 1910: on stones under bridge of main road above Mill; ½ quart with few *N. punctulata.*

July 1932: many at and near surface, felt down to 6 inches on stones and masonry under bridge in slime exposed to full sunshine, in rapid turbid stream.

14. *Great River.* June 1910: head of rowboat access, foot of cascade and remnants of dam, on stones and logs, rapid stream, near surface and on wet rocks in depressions where alga abundant and near holes in old sluice, with *N. punctulata.*

Late July: water muddy and rising in freshet; felt for under loose stones, adherent while the more expanded *N. punctulata* fall off into torrent, herds of *Neritilia,* 50–100 under some stones.

Very dense crowd in depression bearing moss and algae, in square foot 64 *N. virginea,* 765 *N. punctulata,* chiefly young of several broods.

July 1932: rowboat mile from mouth to about same locality. Most of the shells so badly encrusted as to distort shape and lime dissolved in acid reveals green algal threads.

Wading waist deep in torrent feel shells several to square foot on stones, rocks and old tree trunks; do not fall off though most are *N. punctulata.* Egg capsules of both abundant on all stones and cocoanut leaves in water. Those of *N. punctulata* less abundant, may be deeper. Very many *Neritilia.*

15. *Redding, or Retirement, River.* July 1910: where fine clear stream rushes across road, supporting water hyacinths, to supply native washerwomen below road, on stones. Many repairing injured shells; correlated with wheel and hoof traffic on road.

July 1932: no shells to be found, though stream still supported

hyacinths, but workmen paving the road to let water flow across without miring autos; stream below partly diverted to a tannery.

Rock Port Spring. 1932: small pool with large outrush of clear fresh water close to brink of salt water of harbor opposite quarry, said to have arisen after earthquake of 1907, with *N. punctulata*, on bottom with stones and algae.

(*To be continued*)

MOLLUSKS OF THE OQUIRRH AND STANSBURY MOUNTAINS IN UTAH

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This study was undertaken in a region that no malacologist would select for good collecting. The object was to find out what was there, if anything. The results have been quite surprising and informative. The comparatively barren Oquirrh and Stansbury Ranges, immediately south of Great Salt Lake, receive very much less precipitation than the Wasatch Range to the east. The vegetation in most places is scanty and of the desert type, which conditions are very unfavorable for mollusks. The study includes the intervening Tooele and Stockton Valleys, also the eastern slopes of the Oquirrh Range in Jordan Valley.

The author has personally collected in all the localities, but was accompanied by one or more persons on each trip, who were the drivers and who also aided in collecting. These persons were, for each locality (as given by number), as follows: Perry Plummer for localities (1), (6), (13), (15), (16), and (17); Frank F. Daughters for (2), (4), and (5); Thomas A. Hopkins for (3), (14), (20), and (21); Thomas Hopkins and Harden Rowland for (4) second time, (18), (19), and (22); and Calvin A. Richins for (7), (8), (9), (10), (11), and (12). Acknowledgment is made to the Zoölogy Department of the University of Utah for financing both trips in which Thomas Hopkins was driver; also on the same trips to the federal student aid (then F.E.R.A.) for driver's compensation. All collections recorded in this article were made in the spring of 1936.

Localities and stations are as given alphabetically below, the numbers being those used in the preceding paragraph, also in the